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ABSTRACT

This study examines the relationship between the interactive influences of two environmental settings--the home and the school--and three measures of student growth--reading, mathematics, and self-esteem. Each setting was measured along three dimensions of influence--attitudinal, process, and structural. A three stage, multivariate regression analysis was used to examine the data from 1,660 Grade 5 students in 144 classrooms in southern Ontario. Results showed a significant relationship between the problem-solving subtest of mathematics and the interaction of the two settings. But for reading, self-esteem, and mathematics concepts, no evidence of interaction was shown between the home environment variables and the classroom environment variables. (Author)

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The Influence of Environments on Student Outcomes

Paper presented at the
American Educational Research Association
in San Francisco

April 11, 1979

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BACKGROUND

There is a growing body of research that has examined the influence of various environments on the development of children's characteristics. However, most of this research has concentrated on studying one environmental setting, generally either the home or the school. While it is recognized that child development is influenced by multiple environmental settings, we do not have a consistent means of examining these multiple influences from various settings. We need conceptual frameworks which relate the interactive components of various settings to the study of children. These frameworks at a minimum ought to include sets of terms that will allow us to make sense of similar phenomena that often are labelled differently.

In response to this need, the present study is concerned with a conceptualization including a set of terms which will let us look at the interactive relationships of similar phenomena across various settings and their influence on children's growth.

Some Related Research

The more recent recognition of environments as multi-dimensional forces influencing a child's growth is evident in a few large-scale studies over the past fifteen years. These studies are significant in that they represent initial attempts to deal with the influences of more than one environmental setting in relation to student achievement. One study (Husén, 1967) was launched by the International Project for the Evaluation of Educational Achievement (IEA) to compare the influences of the educational system in twelve countries to student achievement in Mathematics. A second major study in England (Plowden, 1967) used a large sample of children to examine the relationships between environmental and genetic factors in the shaping of

human ability. A third large-scale project by Coleman (1966) used a broad sample of children in the United States to examine the critical factors related to the education of minority children.

These three studies are similar in terms of the conceptual framework used to characterize the influence of environments. Each study examined the characteristics of two environmental settings - the home and the classroom - and within each setting the characteristics measured were primarily physical or structural. These three large projects did not examine "process" characteristics which relate more to the interactive qualities of an environment and only one study (Plowden) examined "attitudinal" characteristics of the parents. Generally, the results of these studies showed significant relationships between student achievement and socio-economic factors (SES) of the home environment.

One of the most sophisticated studies of environments was reported by Keeves (1972). Keeves' major contribution lies in the conceptualization of multiple environmental influences and the methodological procedures for incorporating these numerous factors into multivariate regression analyses. Keeves gathered information on the characteristics of three educational environments - the home, the classroom, and the peer group. He examined the relative influence of the characteristics of these three settings on achievement in Mathematics and Science for a sample of 242 Australian children at the Grade 6 level.

In addition to looking at three separate environmental settings, Keeves conceptualized each separate setting as having three major dimensions which are related in varying degrees to educational achievement. These three dimensions are the "structural" dimension which encompasses all the physical

characteristics of a setting, the "attitudinal" dimension which includes the attitudes, beliefs and values of the principal characters of a setting, and the "process" dimension which includes the features of interaction and dialogue among the principal characters of a setting.

Keeves found that the major predictor of achievement was previous achievement but student attitudes and teacher-student interaction also contributed significantly to achievement scores. Although Keeves' study represents major methodological and conceptual progress in the study of environments, there are several deficiencies. First, there was no attempt to specify the characteristics of each dimension in similar terms. For example, the "attitudinal" characteristics of the home environment were not conceptualized and measured in congruent terms with those of the classroom environment so that Keeves was not measuring the same attitudinal features across different setting at the same moment in time. A second major problem in Keeves' results is concerned with the unit of analysis used in the multivariate regression. The analysis was based on the individual child and incorporated both individual and classroom variables. Cronbach (1976) argues that the majority of studies of educational effects, carried out using only one level of analysis, conceal more than they reveal and the established methods have generated false conclusions in many studies. When the individual child is used as the unit of analysis and classroom or group variables are included, the results are biased because of the "contextual" characteristics of the group (Hauser, 1970). A more appropriate model for analysis of multi-level data has been developed by Wiley (1976). Wiley's model of data analysis which is used in this study and will be described in more detail in a following section.

A recent study by McPartland and Epstein (1975) represents another important

contribution to the conceptualization of this area of study. They asked "How does the strength and direction of school effects depend upon the type of family from which the student comes?" The home and school environments were conceptualized and measured along similar terms - the authority structure of the environment. Using commonality analysis they were able to examine the "unique" and "joint" contribution of home and classroom variables.

This study builds upon and extends the conceptualization and analysis of environmental influences from previous research. The main purpose of this study is to examine the interaction of sets of environmental phenomena from different settings and the relationship of this interaction to student outcomes.

THEORETICAL FRAMEWORK

Bloom (1964) has conceptualized an environment as a particular set of forces, forces that range from the most immediate social interactions to the more remote cultural and institutional forces, which influence the development of human characteristics. For this study, the total environment is viewed as a number of different settings each with a unique set of characteristics and two of these settings, the home and the classroom, have been selected as the most significant influences on the development of educational achievement.

The influential characteristics of a setting have been conceptualized by Keeves (197) along three principal dimensions - process, attitudinal and structural. The process characteristics relate to the quality of the interaction patterns between child and adult; the attitudinal characteristics relate to the values, attitudes and beliefs of the influential adult in the

setting; and the structural dimension relates to the physical attributes of a setting.

The major conceptual problem for this study lies in describing and measuring sets of influences which cut across several settings simultaneously. The major characteristics of each setting related to student achievement have been described and measured in similar ways. The process dimension in each setting has been described as the quality of adult-child interaction and opportunities for the child to make decisions which affect him. The attitudinal dimension in each setting has been described as a set of attitudes toward children as learners and beliefs about how children should be treated in a classroom. The structural dimension has been described as the set of physical characteristics - the tangible objects and the physical dimensions - in each setting.

The Process Dimension. For this study an environmental setting is viewed as containing principal actors who interact with a child. In the home environment the parents are the principal actors and in the classroom environment this role is assumed by the teacher. The development of the child is influenced significantly by the interactive patterns with the adults as principal actors in each setting. In the home environment, for example, the child interacts continually with parents and these patterns of interaction shape the child's personality and growth. These interactions provide the models of speech and behaviour which the child imitates and the child's behaviour is shaped through the pattern of reinforcement provided by the parent. On a day-to-day basis the parent stops to chat, to question, to share ideas, to laugh and play, to punish, to praise and to resolve conflicts and the child in response perceives models of behaviour and learns to practise

those activities for which he is praised and to eliminate the accivities for which he is punished. In the classroom environment the teacher as the principal actor provides an identical function as the model of appropriate speech and behaviour and also the source of praise and punishment.

The component of the process dimension of each setting that has been conceptualized in this study is the number and nature of the opportunities provided by the adult for a child to participate in decisions and choices over events and situations which are significant to him or her. It is recognized that the adult in each setting is in a position of authority and is responsible for the health and well-being of the child and in this position the adult would make most of the decisions over what the child can and cannot do. However, in each setting there are a good number of situations and events which occur frequently that afford an opportunity for the child to be involved in the choice of what is to be done. These opportunities can range in nature from "What would you like to do now?" where the child makes an unrestricted decision entirely by himself to "Do you want to do this errand now or after supper?" where a structure has already been imposed but the child is still given a choice.

In the classroom environment there are a large number of areas in which the child may participate in choices over situations which affect him or her. This participation in classroom decisions is conceptualized as representing the influences of the classroom process dimension. The child might be involved in decisions like these - What materials will be used? How will we arrange the learning area? When will we work on Mathematics? How long will be spend on Reading? How well did I do in mastering that content? How can we make this area a quieter, more comfortable place to work?

In the home environment there is also a wide range of situations and events in which the child may participate in making decisions and this participation in decisions has been conceptualized as the influence of the home process dimension. The child could be involved in planning a weekend outing, in choosing a movie, in choosing a TV program, in choosing among a number of foods for dinner, and for some activities, such as how to spend an allowance, the child might be given complete freedom to choose.

Situations occur in each setting where the significant adult has opportunities to involve the child in making choices among events or objects which have relevance for the child. The extent to which the child actually participates in making these choices represents the influence of the process dimension.

The Attitudinal Dimension. The view taken by this study is that the significant adults in each setting possess a set of attitudes and values that have been acquired through their background and experiences. Rokeach (1973) describes a value system as "a learned organization of principles and rules to help one choose between alternatives, resolve conflicts and make decisions". (p.13) The value system of the significant adults in each setting include a set of attitudes concerning the appropriate behaviour for a child in a learning situation and how a child ought to be treated as a learner. It is also assumed that the set of attitudes of the significant adults are antecedent characteristics to actions and behaviours. What an adult says and what he does in interacting with a child is determined to a considerable degree by the firmly held values and attitudes toward children.

The attitudinal dimension of each setting is conceptualized as a set of attitudes toward the child as a learner. The role of the adult and of the child as learner will vary from an authoritarian relationship where the child is essentially a passive recipient to an openly democratic relationship where

the child is essentially an active participant. In the classroom environment the teacher's attitudes toward the child as a learner and the appropriate relationship a child and teacher ought to have is used to represent the attitudinal dimension. In the home environment the parents' attitudes towards the child as a learner is the conceptualization used to represent the attitudinal dimension. It is recognized that parents do not often place themselves in a role in the home that is identical to that of a teacher in a classroom yet it can be argued that if those parents were to assume the role of teacher, they would carry out this role in keeping with their underlying set of attitudes toward children as learners. In this regard the attitudes of parents and teachers are described in identical terms.

Another approach would be to measure parents' attitudes toward children more related to practices in the home environment e.g., child-rearing practices; however, it was felt that a stronger measure of comparison would be attained through a set of identical attitudinal positions for both parents and teachers.

The Structural Dimension. Previous studies of environmental influences have weighed most heavily on the physical characteristics of the home and the school. From the home, features like the size of the family, the floor space per family member and the number of telephones, televisions, magazines and newspapers have typically been used as physical characteristics to represent the influences of the structural dimension. In more recent years another characteristic of the home environment has been used as an index of the physical characteristics - the occupation, education and income of the parents. The relationship between these parental characteristics and the actual physical features of the home is significantly strong to justify using the former characteristics in lieu of the latter as the information about occupation, education and income is much easier to obtain through survey procedures than specifics of the physical features. The occupation, education and income of the parents have been translated through

the use of an alogorithm to an index representing the socio economic status (SES) of the home environment. (In Canada this index has been developed by Blishen (1976)).

This structural dimension of the school is not easily conceptualized in identical terms with the home environment. The characteristics which represent significant variance among home environments do not apply to classrooms. Equality of educational opportunity, which is the responsibility of the central authority, guarantees that each classroom has comparable learning materials and resources. The amount of space per student and the education of the teacher are specified by government regulations, thus achieving a reasonably uniform physical environment for each learning area. One feature of the physical or structural dimension of classrooms which varies significantly is the physical architecture. In recent years a good number of elementary schools have been built with large open space on the interior - "open area of open concept schools" - with several teachers and several groups of children in these open areas. In architectural terms these open areas represent a completely different physical environment than a traditional classroom. Although this feature of the classroom environment is not conceptually identical to the structural dimensions of the home (SES), it will be used in this study to represent the physical influences of the classroom.

PROCEDURES

The data for this study were collected in a large scale longitudinal study of school programs and architecture in Ontario. Achievement in Reading, Problem Solving and Mathematics Concepts and a measure of Self-esteem have been selected to represent different types of student outcomes. Reading, Mathematics Concepts and Problem Solving were selected as reliable measures of traditional school outcomes reflecting cognitive growth; Self-esteem was chosen as a non-cognitive measure of growth reflecting a more non-traditional type of school outcome.

Achievement in Reading, Mathematics Concepts and Problem Solving were

measured by subtests of the Canadian Tests of Basic Skills (CTBS) and Self-esteem was measured by an adaptation of the Piers-Harris Self-esteem Scale. Data were collected in the 1975-76 school year and identical data were collected two years previously in the 1973-74 school year. The 1973-74 data have been used as co-variates to account for student background characteristics. Previous achievement scores represent a wide range of characteristics related to the student's background - intellectual ability, home environment and previous educational opportunities - and as Keeves reported, the strongest predictor of achievement is a previous achievement score. The influence of environments and their interaction cannot be examined until this major source of variance has been accounted for.

All the three dimensions of the home environment - process, attitudinal and structural - were measured by the Parent Questionnaire. This questionnaire was developed by the on-going large-scale study with items that would match environmental data collected from classroom characteristics. For the classroom environment, the attitudinal dimension was measured by the Teacher Questionnaire, the process dimension was measured by the Dimensions of Schooling Questionnaire and the Gump Architectural Index was used to obtain a measure of the structural characteristics of the classroom.

The sample was comprised of 3800 pupils born in 1965 (generally in Grade 5) in 214 classrooms in 72 schools in southern Ontario. The original selection of schools included three architectural types - "closed" schools with traditional classrooms; "open" schools with large open areas; and "mixed" schools with both open and closed areas. Only those pupils with complete data sets for all 14 variables were included in the final analysis - 1,660 pupils in 144 classrooms in 72 schools.

Data Analysis

The model for data analysis used in this study was developed by Wiley (1976) to overcome the problems associated with analyzing data at more than one level - i.e., the individual level where the child is the unit of analysis and a second level where the classroom is the unit of analysis. Wiley states "In examining the basic problem of the assessment of school effects on achievement, for example, we may think of it as the problem of disentangling the effects of variables defined solely at the level of the school ...from those defined at the level of the individual pupil, such as home background characteristics" (p.446). Wiley's model makes appropriate adjustments of the effects of variables defined at both levels, the individual and the classroom, without loss of important information at either level. The model also helps solve the problem of a large number of variables and their consequent collinearity, since all the individual-level variables may be summarized into a single composite variable at the classroom level.

A three stage multivariate regression model was used to analyze the relationships among the variables. The first stage (Level 1) used the individual as the unit of analysis and the regression weights for the home environment variables were used to calculate a composite term. This composite term was carried to the second stage of analysis (Level 2) based on classroom characteristics where regression weights for classroom environment variables were determined and used to calculate a composite term. The third stage of analysis (Level 3) examined any evidence of interaction between the home environments variables and the classroom environment variables.

RESULTS

The major focus of this study was embodied in the third level of analysis, wherein the composite term for the influences of the home environment and the composite term for the influences of the classroom environment were examined for interaction related to four student characteristics - Self-esteem, achievement in Reading, achievement in Mathematics Concepts, and achievement in Problem Solving.

Interaction between home characteristics and classroom characteristics was significant (at the .05 level) for only one student outcome - Problem Solving. There was no significant interaction for Self-esteem, achievement in Reading or achievement in Mathematics Concepts.

The relationships among the environmental characteristics and each outcome measure at all three levels of analysis are described below.

Self-Esteem

The first level of analysis was based on the individual child as the unit of analysis. Self-esteem scores in 1975 were used as the dependent variable in a regression equation which included four independent variables related to the child's background and the home environment: Self-esteem scores in 1973, process characteristics in the home, parent attitudes, and SES. Following Wiley's (1976) model each variable was adjusted by the class mean to eliminate the bias which could be present due to the "contextual" characteristics of the class group.

Only two variables had significant relationships with Self-esteem '75 - Self-esteem '73 with a simple correlation of +0.23 and SES of the home with a simple correlation of +0.08. The purpose of this first level of analysis was to obtain non-standardized regression weights for each of the independent variables which were used to create a composite term representing the

influences of the home at the second level of analysis.

The composite term for the influences of the home was calculated using the following non-standardized regression weights:

(0.0125) (SES) + (0.0112) (Parent attitudes) +
(0.0108) (Home process characteristics) +
(0.3190) (self-esteem '73)

The results of the level 1 analysis are summarized in Table 1.

In the second level of analysis the purpose was to compute non-standardized regression weights for classroom variables while controlling for the influences of the home with the composite term described above. Again, following the model described by Wiley, the mean values of all the variables were used as this level of analysis was based on the classroom.

Mean Self-esteem '75 was the dependent variable in a regression equation with four independent variables - classroom process, teacher attitudes, school architecture and the composite term calculated from the home environment.

Only two variables had a significant relationship with Self-esteem '75 - the composite term from the home environment ($r = + 0.33$) and the classroom process ($r = 0.14$). School architecture in this analysis proved to have a very small but negative relationship to Self-esteem.

This second level of analysis computed the non-standardized regression weights for calculating a composite term for classroom variables as follows:

(0.0777) (Classroom process) + (0.009) (Teacher attitudes) -
(0.0043) (School Architecture)

The results of the level 2 analysis are summarized in Table 2.

The main focus of this study is concerned with the interaction term in the third level of analysis. Mean Self-esteem scores were used as the dependent variables in a regression equation with three independent variables - a composite

term from the home characteristics as obtained in level 1 analysis, a composite term from the classroom characteristics as obtained in level 2 analysis, and the interaction term (composite home) X (composite classroom).

None of the terms in this analysis has a significant relationship with Self-esteem even though the interaction term does have a correlation of +0.299. These results are summarized in Table 3.

Achievement in Reading

Reading comprehension scores were strongly related to the students' background (Reading scores in 1973) and to home characteristics (home process, parent attitudes, and SES). It was expected that the best predictor of reading achievement would be previous reading test scores and the results confirmed this. The correlation coefficient for reading '75 and reading '73 was r=0.714. Two of the home characteristics were found to have significant relationships with reading scores - parent attitudes (an F-ratio of 2.65, significant at the .05 level) and SES (an F-ratio of 6.74, significant at the .01 level).

The non-standardized regression weights for the independent variables of this first level of analysis based on the individual child as the unit of analysis are listed in Table 4. The composite term for home characteristics was calculated in this way:

(0.1306) (Parent attitudes) + (0.0524) (home process) + (0.0482) (SES) + (0.8020) (Reading '73)

The results of the second level of analysis for reading are listed in Table 5. None of the three classroom variables were found to have a significant relationship with reading scores; however, the strongest correlation with reading was school architecture (r= +0.131). At this level of analysis based on the classroom, 78% of the variance of reading scores was explained by the composite term from the home characteristics and the student's background.

The composite term for classroom characteristics was determined by using these weights:

(0.0223) (Teacher attitudes) + (0.0648) (Classroom process) + (0.1949) (School Architecture)

Table 6 illustrates that the interaction between home characteristics and classroom characteristics did not have a significant relationship with reading scores. Again, the composite term from the home was significantly related to reading but there was not a significant relationship for the composite term from the classroom or the interaction of these two terms.

Achievement in Mathematics Concepts

Analysis of Mathematics Concepts scores at the individual level revealed that previous achievement scores explain 35% of the variance and this variable is the best single predictor of achievement in Concepts of Mathematics. Among the three home characteristics only SES was found to have a significant relationship and this was significant at the .01 level (the F-ratio was 5.59).

Table 7 illustrates the weights for the independent variables which were used to calculate the composite term for the home and background characteristics. The calculation was made as follows:

(0.0404) (Parent Attitudes) + (0.0208) (Home process) + (0.0271) (SES) + (0.7107) (Math concepts '73)

When Mathematics Concepts scores were analyzed at the classroom level, only the composite term from the home and background characteristics was significantly related because of the strong influence of previous Math achievement scores. Among the three classroom characteristics school architecture had the strongest correlation and the relationship was negative (-0.16). Teacher attitudes had the highest F-ratio (1.189) among the three classroom characteristics but this value was not significant at the .05 level (see Table 8).

The composite term for the classroom variables was calculated using these weights:

(0.0596) (Teacher attitudes) - (0.0208) (Classroom process) - (0.0144) (School architecture)

The interaction between home characteristics and classroom characteristics on achievement in Mathematics Concepts was not significant. The composite term for the home characteristics was significant (explaining 49% of the variance) but the relationship between Math Concepts scores and classroom characteristics was very small. These results are illustrated in Table 9.

Achievement in Problem Solving

Problem Solving was the only outcome measure in this study significantly related to the interaction of home characteristics and classroom characteristics, yet the analysis at level 1 and level 2 appeared very similar to the three other outcome measures.

Again, only SES of the three home characteristics had a significant relationship with problem solving scores with an F-ratio of 9.73 (significant at the .01 level).

The regression weights used to calculate the composite term for analysis at the individual level are listed in Table 10.

(0.0201) (Parent attitudes) + (0.0265) (Home process) + (0.0307) (SES) + (0.6224) (Achievement in Problem Solving '73)

At the second level of analysis the composite term representing the students' background and home characteristics accounted for 52% of the variance of problem solving scores. Among the three classroom characteristics only school architecture was significantly correlated with problem solving scores and the relationship was negative ($r = 0.16$). That is, higher scores in problem solving were achieved by children in schools with more traditional architecture. Teacher attitudes and classroom process had very little relationship to problem solving scores (see Table 11).

The composite term for classroom variables was calculated using these regression weights:

(0.0183) (Teacher attitudes) - (0.0394) (Classroom process) - (0.1213) (School Architecture)

At the third level of analysis the interaction term between home characteristics and classroom characteristics was significantly related to problem-solving scores with an F-ratio of 2.44 significant at the .05 level. These results are illustrated in Table 12. This analysis indicates that characteristics of the home and characteristics of the classroom may be working together interactively to develop some additional skill in Problem-Solving.

DISCUSSION

The results of this study indicated that the interaction of the home and classroom environments did have an influence on Problem-Solving but did not have a significant effect on Self-esteem, Reading or Mathematics Concepts. The important issues for this discussion are first, to explore why problem solving had a significant relationship and to consider the possibility of a Type I error, and second, to explore why Self-esteem, Reading and Math Concepts were not significantly related to interaction and to examine the probabilities of a Type II error.

For Problem Solving, we might first consider the case that the results reflect reality; that is, there is indeed an influence on this student characteristic brought about by the interaction of the two environments. It can be argued that Problem-Solving is unique amont the four outcome measures in the specificity of the cognitive tasks required to respond correctly to the items of the subtest. The items of the Problem Solving subtest have been designed, according to the developers of the Canadian Tests of Basic Skills (CTBS), to represent "realistic problems in fresh

situations which are novel for the individuals asked to solve them". The developers of CTBS go on to explain that "many problems found in current textbooks and tests do not call upon the pupil to work out anything new; rather modelling, imitation, and recall are the main behaviours involved in the solution". But in contrast, the items of this subtest require abstract thinking and critical analysis about problems which are novel to the child.

Certain types of curriculum experiences in a classroom would lead to a higher development of these cognitive, analytic skills than other types of classrooms where the curriculum placed a stronger emphasis on other kinds of outcomes (e.g., imitative or modelled responses). In a classroom where the curriculum placed a priority on Problem Solving skills, students could be expected to achieve higher scores on the problem solving subtest of CTBS. This type of cognitive skill would appear to be the kind that is very dependent upon classroom activities - a "curriculum-dependent" skill. Using this categorization, other types of skills (e.g., reading) could be described as more general in nature and not so specifically related to classroom activities - a "curriculum-independent" skill. The point to be made is that Problem Solving, because of the nature of the task, would appear to be related to the learning opportunities provided in the classroom environment.

Classroom programs vary along many dimensions which relate to learning opportunities - one of the most important being time. In classes where children spend more minutes per week on cognitive activities related to Problem Solving, it seems clear that these children will achieve higher scores on Problem Solving tasks. Yet, the different programs provided by classrooms for Problem Solving represent a far more homogeneous group of environmental settings than the home environments of these children.

Home environments are providing a far more heterogeneous group of settings than classrooms for the development of cognitive skills related to Problem Solving. Because classroom programs are mainly centred around cognitive activities, children would have at least some opportunity to develop Problem Solving skills. However, home environments generally are not structured around cognitive activities and tasks and the degree of variance for opportunities to develop Problem Solving skills in home environments would be far greater than for classroom environments.

One can imagine that some home environments provide many opportunities for the children to engage in abstract thinking and the children are encouraged to solve problems or deal with concerns with an analytical orientation. In these home environments the parents would also be providing the models for abstract thinking which the children would be observing and emulating. These home environments would be rich in the variety of games, materials and puzzles, along with the parental encouragement to use them, that would lead to the development of abstract thinking. On the other hand one can also imagine home environments where none of these materials or activities are present because of the nature and the characteristics of the parents. While this "non-abstract-thinking" environment could well be an idea setting for love and concern, the children here would not have opportunities to develop the kinds of cognitive skills that are part of getting right answers on the Problem Solving subtest of CTBS.

It can be argued then that the results for Problem Solving, where the interaction term between the home and the classroom environments was significant, makes sense. The nature of the task, which is associated with abstract thinking, is highly dependent upon the opportunities provided in an environment to develop these skills and where both the home and the

classroom provide these opportunities simultaneously, an additional effect is brought about.

If only one student outcome, Problem Solving, had been used as the dependent variable in this study, it would be much more difficult to assess the probability that the significant effect of the interaction term did or did not represent the real world - i.e., the probability of a Type I error. Because there was no significant effect for interaction on Self-esteem, Reading or Math Concept scores and because Problem Solving appears to be a "curriculum-dependent" skill, it is easier to accept the results for Problem Solving as being a reasonable representation of the influence of both environments working together.

The results for Self-esteem, Reading and Math Concepts, which did not have a significant relationship with the interaction of the two environments, may represent what is really happening in the development of these three student characteristics. As the results indicate, there may be no interaction between the two environments and these student outcomes or the interaction may be too small or of a different nature to be measured accurately with the instruments used in this study.

These results can be viewed as reasonable primarily from the same arguments developed in the previous discussion of Problem Solving. The nature of these three characteristics can be viewed as very general in the sense that their development does not depend so completely on a particular set of learning opportunities in the home and the classroom. The nature of classroom activities embodies a complete language arts curriculum. Each day children must listen to the teacher and to classmates, speak to the teacher and to classmates, write in response to specific instructions, and read material provided by the teacher. Thus the components of the

language arts curriculum pervade all areas of classroom activities so that no matter what subject area the child is attending to, the activities will include listening, speaking, writing or reading. Reading, as well as Self-esteem and Mathematics Concepts, is not a single or isolated characteristic, but rather these three characteristics are each composed of many interrelated components with each component being influenced by a number of characteristics in each environment.

For example, Reading Comprehension is generally viewed as a complex set of interrelated skills which include the specific components of making inferences, drawing conclusions, predicting outcomes and so on. The development of this complex set of skills goes on as a regular part of the language arts curriculum which encompasses most classroom activities and does not depend so completely upon a specific curriculum or set of learning activities provided by the teacher. Self-esteem, as a student characteristic, would appear to fall into this same category of outcome as Reading Comprehension in the sense that it is a global, rather than a specific, quality. The development of Self-esteem like the development of Reading Comprehension is an on-going process that cuts across all areas of the curriculum and is influenced either positively or negatively each time the teacher interacts with the child. Each positive sanction and each opportunity the child is given to succeed adds to the child's "good feelings" about his or her self. Teachers would agree that helping children feel good about themselves as individuals is an important part of the curriculum but it is a broad aim rather than an instructional objective in the sense that teachers do not plan specific lessons in Self-esteem in the same way that they would plan activities to solve Mathematics problems.

The development of Concepts in Mathematics is obviously not a broad,

global curriculum aim in the same category as Self-esteem, and yet the development of Concepts in Mathematics is not a specific skill in the same category as Problem Solving. Concept development proceeds slowly over an extended period of time where additional information is processed over time to expand the original concept into increasingly broader understanding. For example, an average 6-year-old child can comprehend the concept of "one-half" but in a limited range of situations - probably not much beyond "one-half of an apple"; whereas, an average 10-year-old can comprehend "one-half of one-half" - the same concept but extended beyond the complexity of a single unit. The point to be made is that an understanding of Mathematics Concepts is more like Reading and Self-esteem, in that it does not depend so completely on the curriculum of one classroom but probably depends more upon the cumulative learning experiences of several classrooms.

The argument that Reading, Self-esteem and Mathematics Concepts are broad, general characteristics which are not "curriculum-dependent" upon the classroom setting would seem to hold equally well for the influences of the home environment. All homes have a curriculum in language arts and this curriculum is probably quite homogeneous within a given socio-economic range. Using the same four language functions that underlie the classroom curriculum, it is probably the case that, generally, home environments encourage a good deal of listening activities, a fair degree of speaking activities, perhaps some reading activities, and only a few, if any, writing activities. Home environments are providing some opportunities for growth in language arts and even though there are differences among home environments in the frequency and type of language activity, it is still the case that children are exposed to a world filled with language experiences of many sorts in many different settings. A major environmental setting not included in this study, the

child's peer group on the playground also functions through the use of language.

Skills in language, including Reading as well as Self-esteem and an understanding of Mathematics Concepts, can be viewed as more complex, general characteristics in contrast to a more specific characteristic as exemplified by the cognitive skill of solving problems. These broader, more complex characteristics would develop more slowly over an extended period of time, they would be influenced and shaped by the child's experience in a range of environmental settings, and they would be quite stable in the sense that they would be fairly resistant to rapid change or growth in a particular direction because of the influence of one environment for a short period of time.

The results of this study seem to be consistent with Coleman's (1975) re-examination of IEA data. Coleman used achievement scores in Reading, Mathematics and Science as criterion measures and examined relationships with home background characteristics and school characteristics. The results indicate that environmental influences are subject-specific. Reading achievement is more fully an outgrowth of home influences than are either of Mathematics or Science. Reading achievement is less a function of what takes place at school. Coleman states, "this is a rather important result, because it indicates that the general finding in this study and in others that home background is a much more powerful influence than school characteristics in determining achievement is a result that is subject-specific". (p.382)

Considering the results for Reading, Self-esteem and Mathematics Concepts from another point of view, it is possible that significant differences do exist from the interaction of the two environments but they have not been detected by the methods used in this study. Gage, in a recent

article in Phi Delta Kappa (November, 1978), addresses this problem after summarizing a good deal of the major research on the effects of teaching. "By basing their clinical judgment primarily on the statistical significance of the results of single studies, they (the researchers) risk committing to a large degree an error of Type II - that is, an error of considering a relationship or difference to be nonexistent when it does in fact exist". (p.230). Gage goes on to point out that the teaching-learning process is so complex that any single significant variable in teacher behaviour should only be expected to have a low correlation (+.1 to +.4) with any measure of student achievement and in light of this "most of the single studies should not be expected to yield statistically significant results". (p.230).

One of the most serious limitations of this study concerns the quality of the data collected for some of the independent variables. The four student outcome measures, which were used as dependent variables, are widely accepted as the best available and most reliable measures of student achievement and while these measures may be less than perfect, they are recognized and used as the current standard in research on learning and classrooms.

The data for this study was taken from a larger on-going project that had much broader and a more diversified set of research questions relating to student outcomes. The larger on-going study collected data on teacher characteristics, program characteristics, school characteristics, principal characteristics, home characteristics, as well as a wide range of student characteristics. The study reported here used data collected in the larger study. While there were major advantages to using this data (the most important advantage being the large sample size), there were significant limitations in the instruments and methods used to measure environmental variables. Conceptually, the environmental instruments would measure the same process, attitudinal, and structural dimensions across the home and the school,

gauging environmental influences across two settings at the same time.

The data for the home environment was collected by questionnaire and while the return was exceptionally good for a survey instrument, this data-collecting procedure is probably less than effective for tapping the important qualities of a home environment. When the environmental characteristic to be measured is the pattern and quality of interaction between the parent and the child (the process dimension of the home environment), the more appropriate data-collecting procedures would be individual interviews with parents and children along with observation of home interaction patterns - procedures demanding excessive expenditures of time and money.

The question of validity of the data for the process characteristics of the home is an important one. While the items of the Parent Questionnaire related to process characteristics were developed using a conceptual framework similar to the instrument for process characteristics of the classroom, there are no doubt a number of significant differences between the two environments which exist but which were missed or overlooked by the Parent Questionnaire. This study attempted to measure the same environmental characteristics across two settings and because no instruments with established validity and reliability were available, they had to be developed. Some of the instruments have not undergone a rigorous development process; rather they represent a first attempt at a complex task which has been pointed to as a need but not previously undertaken.

The instrument used to measure the process characteristics of the classroom was the Dimensions of Schooling Questionnaire (DISC) developed by Traub, Weiss and Fisher (1974). This instrument has undergone several revisions and a fairly rigorous development process in an attempt to quantify the degree of openness in a classroom - defined as the extent to which opportunity for

student choice is maximized (Traub, Weiss and Fisher, 1974, 1976). Recently the developers of DISC have re-examined the questionnaire in terms of a conceptualization of openness suggested by Hill (1975). Hill identifies two types of openness, "normative" where 'the choice of learning tasks and activities shall be entirely the prerogative of the students'.(p.7) and, "procedural" where 'the classroom may be termed 'open' because children move in, around and out of the classroom at will, or because there is little use of bells to prescribe lesson segments, or because age and sex discrimination have been abolished, or because traditional school subjects have given way to integrated learning activities, or any combination of these'. (p.6)

A factor analysis of teacher responses to DISC by Traub and Weiss (1978) revealed that open education in Ontario elementary schools has three major dimensions - student independence, involvement of teachers in structuring the school program, and organization of vertical progress through school - all components of "procedural" openness. One primary limitation to DISC which was pointed out by Traub and Weiss (1978) is a limitation which applies as well for this study. The results of DISC "rest on a self-report measure of program practice". (p.32). It is recognized that there are considerable differences between what teachers report doing (particularly on a survey questionnaire) and what they actually do in practice. So again, the data on the classroom process characteristics as with the data from the home have significant limitations.

A brief comment is in order concerning the results of the first level analysis based on the individual. The most important characteristic of the home for all four outcome measures was SES where in all four analyses the relationship with SES was statistically significant. The socio-economic index (SES) of each home was determined by matching the parents' job

description with the occupations listed in the revised Blishen Scale (1976). For each occupation in the scale a socio-economic index has been calculated based on education and income. For the present study this index is the best predictor of academic achievement and Self-esteem. This index probably reflects the quality of the educational environment of the home. Where the parents have more education and a higher income, the materials for playing and reading, the level and frequency of conversation, and the patterns of interaction provide an environment which is conducive to the development of skills which form a major part of the school curriculum.

SUMMARY

The interaction of the home and the school environments may have a significant influence on Problem Solving skills with no apparent influence on Reading, Self-esteem or Mathematics Concepts. These results may be related to differences in the outcome measures themselves. Reading, Self-esteem and Mathematics Concepts are more complex, more general characteristics which develop slowly over time and are less dependent upon the curriculum of the classroom.

The primary limitation of this study centres on the instruments used to measure the environmental characteristics. The task of measuring three environmental dimensions across two settings is complex and the characteristics to be measured are subtle. This study represents an initial attempt to deal with these complexities.

Tabl

Individual Characteristics (Lev

Variables	Multiple R	R^2	Sim
Self-esteem '73	0.230	0.053	0.
Home Process	0.232	0.053	0.
Parent Attitudes	0.232	0.054	0.
SES	0.240	0.057	0.

e 1

el 1 analysis) and Self-Esteem

ple R	B	Beta	Std. error B	F
230	0.319	0.226	0.033	89.442
034	0.010	0.020	0.013	0.649
022	0.011	0.012	0.022	0.256
076	0.012	0.059	0.005	6.241

Table

Classroom Characteristics (Level

Variables	Multiple R	R^2	Sig
Composite Term (Home)	0.328	0.107	0
Classroom Process	0.375	0.141	0
Teacher Attitudes	0.378	0.143	0
School Architecture	0.378	0.143	-0

e 2

l 2 analysis) and Self-Esteem

mple R	B	Beta	Std. error B	F
.328	0.112	0.347	0.253	19.647
.143	0.077	0.166	0.039	3.936
.102	0.009	0.051	0.014	0.379
.027	0.004	-0.008	0.038	0.013

Tab

Home and Classroom Interaction (

Variables	Multiple R	R^2
Home Composite	0.328	0.107
Classroom Composite	0.378	0.143
Interaction Term	0.382	0.146

le 3

Level 3 Analysis) and Self-Esteem

Simple R	B	Beta	Std. error B	F
0.328	-0.433	-0.134	2.127	0.042
0.154	-0.041	-0.777	6.890	0.350
0.299	0.999	1.037	1.353	0.545

Tabl

Individual Characteristics (Level

Variables	Multiple R	R^2
Parent Attitudes	0.081	0.006
Home Process	0.103	0.010
SES	0.160	0.025
Reading Scores '73	0.717	0.515

e 4

1 Analysis) and Reading Achievement

Simple R	B	Beta	Std. error B	F
0.081	0.130	0.033	0.080	2.653
0.081	0.052	0.022	0.048	1.162
0.129	0.048	0.052	0.018	6.739
0.714	0.802	0.705	0.023	1200.683

Tabl

Classroom Characteristics (Level 2

Variables	Multiple R	R^2	S
Teacher Attitudes	0.040	0.001	
Classroom Process	0.064	0.004	
School Architecture	0.138	0.019	
Composite Term (Home)	0.896	0.803	

e 5

Analysis) and Reading Achievement

imple R	B	Beta	Std. error B	F
-0.040	0.022	0.015	0.057	0.148
-0.061	0.064	0.015	0.177	0.134
-0.130	0.194	0.051	0.148	1.726
0.894	0.122	0.907	0.051	553.933

Table

Home and Classroom Interaction (Level

Variables	Multiple R	R^2	Si
Composite Term (Home)	0.894	0.799	0
Composite Term (Class)	0.896	0.803	-0
Interaction Term	0.896	0.803	0

6

3 Analysis) and Reading Achievement

mple R	B	Beta	Std. error B	F
.894	0.014	1.063	0.363	15.476
.136	0.025	0.154	2.754	0.867
.763	0.539	-0.165	0.092	0.342

Tabl

Individual Characteristics (Level 1 Analysi

Variables	Multiple R	R^2	S
Parent Attitudes	0.056	0.003	
Home Process	0.082	0.006	
SES	0.131	0.017	
Achievement '73	0.602	0.362	

e 7

s) and Achievement in Mathematics Concepts

imple R	B	Beta	Std. error B	F
0.056	0.040	0.019	0.049	0.663
0.071	0.020	0.016	0.030	0.479
0.109	0.027	0.055	0.011	5.586
0.598	0.710	0.591	0.028	644.126

Tab

Classroom Characteristics (Level 2 Analys

Variables	Multiple R	R^2	S
Teacher Attitudes	0.031	0.000	
Classroom Process	0.083	0.006	-
School Architecture	0.180	0.032	-
Composite Term (Home)	0.701	0.492	

le 8

is) and Achievement in Mathematics Concepts

Simple R	B	Beta	Std. error B	F
0.031	0.0596	0.070	0.054	1.189
0.060	0.0208	-0.00835	0.162	0.016
0.160	0.0144	-0.00641	0.139	0.011
0.698	0.0124	0.69943	0.110	125.745

Tabl

Home and Classroom Interaction (Level 3 Anal

Variables	Multiple R	R^2	S
Composite Term (Home)	0.698	0.487	
Composite Term (Class)	0.701	0.492	
Interaction Term	0.702	0.493	

le 9

lysis) and Achievement in Mathematics Concepts

Simple R	B	Beta	Std. error B	F
0.698	0.019	1.126	1.108	3.241
0.054	0.051	0.348	6.050	0.712
0.614	0.242	-0.508	0.353	0.471

Tabl

Individual Characteristics (Level 1 Anal

Variables	Multiple R	R^2	S
Problem Solving Scores '73	0.552	0.305	
Parent Attitudes	0.552	0.305	
Home Process	0.553	0.306	
SES	0.558	0.311	

e 10

ysis) and Achievement in Problem Solving

imple R	B	Beta	Std. error B	F
0.552	0.622	0.546	0.027	509.851
0.030	0.020	-0.011	0.042	0.223
0.069	0.026	0.025	0.025	1.050
0.114	0.030	0.075	0.009	9.733

Tab

Classroom Characteristics (Level 2 Ana

Variables	Multiple R	R^2	St
Composite Term (Home)	0.718	0.516	0
Teacher Attitudes	0.718	0.516	-0
Classroom Process	0.719	0.517	-0
School Architecture	0.724	0.524	-0

ble 11

alysis) and Achievement in Problem Solving

mple R	B	Beta	Std. error B	F
.718	(0.100)	0.708	0.083	144.653
.000	(0.018)	0.034	0.033	0.297
.057	(-0.039)	-0.024	0.099	0.155
.163	(-0.121)	-0.084	0.084	2.065

Tab

Home and Classroom Interaction (Level 3 A

Variables	Multiple R	R^2	S
Composite Term (Class)	0.633	0.401	
Composite Term (Home)	0.718	0.516	
Interaction Term	0.725	0.525	

le 12

nalysis) and Achievement in Problem Solving

imple R	B	Beta	Std. error B	F
0.633	-0.232	-1.063	0.148	2.442
0.718	0.023	1.655	0.856	1.721
0.019	0.028	0.540	1.721	2.650

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